★ DECEMBER

Amateur RADIO DIGEST

SIXPENCE

Amateur Direction Finding

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EDITORIAL

In this issue we commence a new Short Wave Listener's Section. The Magazine Committee has always tried to adapt its policy to changing conditions and, since the outbreak of war and the cancellation of all experimental licences, articles of more general interest have been published. Most amateurs received their introduction to radio through the medium of short wave listening and we hope, through the new section, to cater still more for the short wave listener—who will be the ham of the future.

If we are to cater for the short wave listener, the magazine must be, of necessity, more readily available and Amateur Radio may now be purchased through any newsagent.

With this issue we complete our eighth year of publication and although the past twelve months have been the most difficult of our existence, I venture to say that the magazine is a better publication now than at any other stage of its existence. To requote from a letter first quoted in the Editorial of the second issue published—Mr. Malone (then Chief Inspector of Wireless) wrote: "The first number is a good one, worthy of its authors. There are better ones to follow. I know that because I know wireless amateurs never will let well alone, they want something better. Their happy combination of optimism, energy and ability will also ensure progress from success to success . . . . ".

Our optimism and energy have enabled us to surmount many difficulties, the greatest of which has been the probelm of maintaining a progressive magazine during a period in which we have been denied the opportunity of continuing our experimental activities. Nevertheless, the magazine has maintained the interest of a large body of experimenters and intends to increase its value and popularity among short wave listeners by publishing a series of technical and constructional articles of general interest to this section of our readers.

AMATEUR DF

DESIGN OF A SIMPLE DIRECTION FINDER

By Alexander Black

("Wireless World.")

★ ★

A very interesting branch of wireless experimenting for amateurs is that connected with the directional properties of frame aerials. Direction finding by wireless is primarily used by ships at sea during foggy weather and, of course, by aircraft as well. It has no wreached a state of great reliability and precision in these spheres of usefulness.

Up to the outbreak of war, direction finding was an important activity of several wireless societies, notably of the Hendon and Golders Green Radio Society. Many amateurs had attained a high measure of skill, and anyone unable to take bearings within a margin of error not exceeding about two degrees stood a poor chance of winning a prize at the competitive field days that were organised periodically. It should be pointed out that this high order of accuracy was commonly attained with relatively simple and inexpensive portable apparatus. In practice it has been found that with a fairly skilful operator and a well-made receiver bearing can be taken to within 1°, up to a range of about 15 miles on 14 metres, therefore any error greater than this must be due to either the transmitter position in relation to the receiver or the effect of the objects in the immediate vicinity of the receiver or to atmospheric conditions. All this goes to show that amateur direction finders are far from being toys, and that the subject is worthy of the attention of anyone who treats wireless as a serious hobby.

Dealing now with the actual direction finding receiver and associated equipment, it is assumed that a receiving set employing a loop or frame aerial will be used, therefore let us briefly consider the theory of the directional properties of a loop. Referring to Fig. 1, assuming the frame to be of square section, a signal from a transmitter lying in the same plane strikes the frame first at X then a fraction of a second later at Y. Then

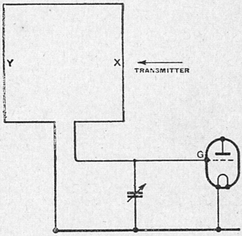


Fig. 1.—Explaining directional reception by means of a frame aerial.

if the dimensions of the frame are small in comparison with the signal wavelength, the voltages induced in opposite sides of the loop will be very nearly equal (the voltages induced in the horizontal portions will be zero and will have no effect on the circuit). When the voltage induced by the signal wave is a maximum in X it will be slightly less in

Y. It is the difference between the voltages at X and Y which causes a current to flow round the loop, thus producing a Pd across grid and filament of the valve at G. If the frame is now rotated through 90° so that the plane of X and Y are at right angles to the transmitter, the voltages induced in X and Y will be equal at any given moment and there no current will flow in the loop. If the frame is rotated a further 90° X and Y will again be in the same plane as the transmitter and current will flow, due to the difference of voltage, but as the wave will now strike Y before X the PD at G will be in the opposite phase. Rotating the frame through 360° the resultant PD at G may be plotted as the well-known figure-of-eight diagram, Fig. 2. It will be seen that the two points of minimum signal M and N are far more clearly defined than the points of maximum, hence the reason for always taking bearings on the minimum signal.

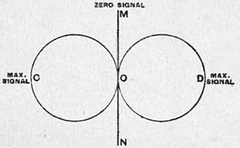


Fig. 2—The "figure-of-eight" diagram represents the waxing and waning of signal strength that occurs as a frame is rotated through 360 degrees.

Unfortunately, the frame aerial as a whole acts as an ordinary aerial due to its capacity to earth; this pick-up effect is practically the same irrespective of the plane of the frame to the transmitter. This is known as "vertical effect." The voltage applied at G by the vertical component of the signal can be represented as in Fig 3 by a circle AB with its centre at o. It will be realised that with the plane of the frame as in Fig. 1 the signal due to vertical effect may be in phase with, and therefore additive to, the signal received by the loop and can be shown as OE. When the frame is rotated through 180° the two signals will be out of phase and can be shown as OB. The result is that the minima M. O. N are distorted instead of being at 180° as in Fig 2. Vertical effect also causes another trouble—that is, blunt or indefinite minima. It is possible to eliminate most of the vertical pick-up in frame aerials by connecting the centre tap to earth as in Fig. 4. The loop should always be wound as a solenoid, and for best results should have an electrostatic screen earthed to the centre tap of

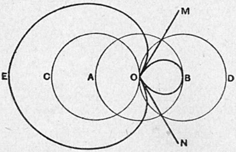


Fig. 3—Polar diagram showing strength of signal received by a frame combined with the signal due to the action of the frame as a vertical aerial.

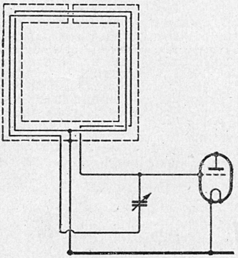


Fig. 4—"Vertical effect" which gives rise to errors, is minimised by centre tapping the frame and enclosing it in an almost complete screen.

the loop. It will be noticed that a gap is left at A to prevent the screen forming a closed loop.

Having taken the above precautions there will only be a very small amount of "vertical" to eliminate and this can be made use of to give a sense bearing, i.e., to show in which of the two possible directions the transmitter lies. If a small vertical road aerial is coupled either to one

side or the other of the frame aerial by means of a small differential condenser, as in Fig. 5, a little of the vertical component of the signal may be deliberately introduced in such a way, say, that it is in phase at one minimum position with the "vertical" signal due to the loop itself. This will cause an indefinite minimum, but if the frame is now rotated through 180° the injected signal from the "open" aerial will be out of phase with the loop signal and a sharp minimum will be obtainable. Instead of rotating the frame the differential condenser can be adjusted so that the vertical aerial is coupled to the other leg of the loop; again, only one sharp minimum will be obtainable on a transmission.

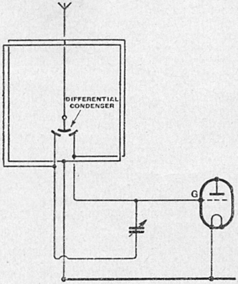
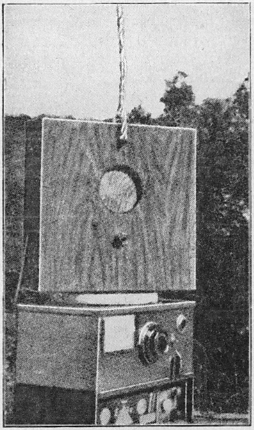


Fig. 5—Use of a differential condenser for balancing out "vertical effect."

Various types of receiving sets were used in the early days of amateur DF, but probably the most popular circuit was the Reinartz or Hartley detector followed by one or two stages of AF amplification; very little was done in the way of screening. Results, however, tended to be erratic as, owing to an oscillating frame aerial, body effects were troublesome and minima were indefinite and unreliable. Great improvements were effected by completely screening the receiver in metal and taking precatutions to prevent direct signal pick-up on the headphone and battery leads. A further improvement was made by using an RF stage coupled to the detector by a tuned anode or tuned grid circuit, reaction being obtained by variable capacity coupling to the coil. The frame aerial now being non-radiating, some of the body effects were eliminated.

A Practical Design.

A typical circuit for an amateur direction finder is shown at Fig. 6. It will be seen that the frame has an earthed tap and a small vertical aerial is coupled by a differential condenser to either end of the frame winding. The tuning condenser must, of course, be insulated from chassis when mounting. The grid leak of the detector valve is taken to a potentiometer across the filaments so that adjustment can be made for smooth reaction, which is always desirable, particularly if the set is used in an oscillating condition for taking bearings on CW stations. The detector valve may be followed by one or two stages of AF amplification. The author prefers two stages as shown; when dealing with a minimum signal



The author's D.F. unit. Note the loud speaker in the centre of the frame.

for taking bearings it is a great advantage to have plenty of magnification.

In the early days of DF the problem of indefinite minima was always a worry; on some occasions, as the frame was turned through 180°, the change in volume on headphones would vary from, say, R7 down to R2, and up again to R7 with no definite dip in volume to identify the minimum position of the frame. The only thing to do under these circumstances was to swing the frame backwards and forwards over the minimum and note a position on either side on which the signal appeared to be the same volume and then take the mean position as minimum. As can be readily understood, it was very much guesswork and sometimes it was impossible to get nearer than 10°, at other times, however, it would be easy to get the signal to completely disappear over about 1°. The author found that a compass scale fitted to the frame was a great help, as it was possible to re-check a bearing or see if the reciprocal bearing, i.e., the frame turned through 180°, coincided. The cause of the indefinite minima obtained was puzzling at first, as a receiver might be in one position for, say, four different transmitter positions and the sharpness or otherwise of minima obtained would vary greatly. It was found that the vertical component of the signal wave could vary during the day and that different transmitter positions also caused a variation. Fitting a small vertical aerial as shown in the circuit overcame this trouble.

For 40 metres, four turns on a 10in. square is suitable for the frame, with a spacing of 5/16 in. between each turn. The author prefers a wooden box type frame, as it is mechanically rigid and protects the winding. When winding the aerial great care must be taken to see that the wires are taut and that the plane of each turn is parallel to the side of the frame case. The electrostatic screen should be at least $1\frac{1}{4}$ in. away from the winding of the frame. The screen can be made of copper foil bent into channel section approximately 3in. wide with $1\frac{1}{4}$in. sides; the gap at the top need only be about $\frac{1}{8}$in. The frame itself can be made of $\frac{1}{2}$in. wood, outside dimensions being 14in. square by 4in. The copper foil screen is fixed by drawing pins. To the bottom of the frame is fixed a piece of wood $7\frac{1}{2}$in. in diameter $\frac{3}{4}$in. wide, which is marked out 0-360; a pointer is fixed to the lid of the set.

The set itself is completely enclosed in a copper box with the battery compartment below. It is important that the wires connecting each end of the loop to the set are individually run in screened tubing, earthed or something similar, in order not to upset the tuning whilst swinging the frame. Similarly, if a loud speaker is fitted in the centre of the frame as in the writer's set, the leads to it must be screened.

It is hoped to deal in a subsequent article with the best way of operating the set and taking bearings.

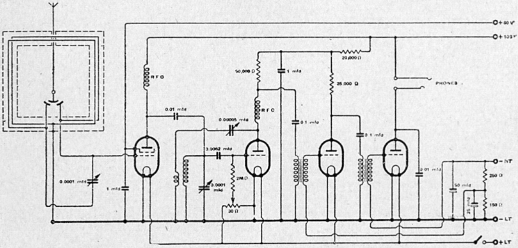


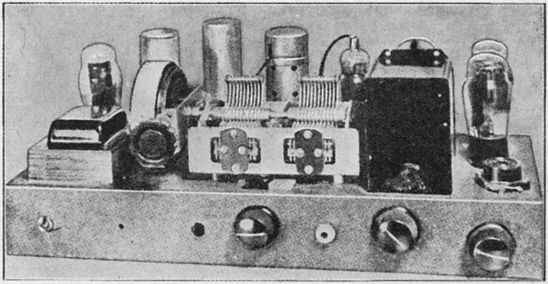
Fig. 6—Complete circuit diagram of the author's receiver.

POORMAN'S HIGH FIDELITY RECEIVER

By James Fulleylove
("Radio News.")

A nice high-fidelity receiver for the man who cannot afford to spend a whole lot for parts. It is easy to construct.

Judging by the majority of magazine articles to be read on the subject of high-fidelity broadcast receivers, one is very apt to get the impression that high fidelity and high cost go hand in hand, inseparably. Fortunately this is not the case. If one is willing to go without the numerous gadgets usually associated with the modern hi-fi receiver but which really contribute more to ease of operation than quality of reproduction, he can build a set like the one described for as little as $12 and still enjoy reproduction equal in quality to that of commercially built sets costing from four to eight times as much.



The panel is left off. The reader may use his own ideas on that.

Upon first glance at the circuit, the reader will probably be struck most by its simplicity; for this was the theme kept in mind throughout its design. The single t.r.f. stage provides just the right amount of selectivity to separate broadcast stations 10 kc. apart and yet pass sufficient side-bands to ensure good high-frequency response. There is not an over-abundance of sensitivity, but quite good enough for good reception of local stations. This is **not** supposed to be a DX receiver.

In the interests of good base response, it is important to use large bypass and coupling condensers in the audio section. Due to the presence of the push-pull output stage and the phase-inverter, no audio voltages are present at the cathodes of these stages, and consequently no bypass condensers are needed here. There is, however, a large audio

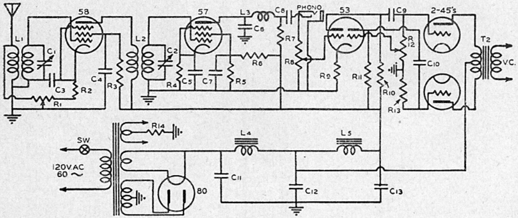
frequency voltage built up across the detector bias resistor, and a 25 mfd. condenser is imperative for adequate bypassing at this point. As for the coupling condensers, a larger capacity than .05 mfd. does not seem to warrant itself.

The adjustment of the phase-inverter is quite simple; and while the use of a v.t. voltmeter or oscilloscope will give the most accurate results, a pair of headphones will do quite well. Simply connect whatever you have across first R12 and then R13, with some sort of steady signal applied to the amplifier input; and adjust the slider on R12 until the voltage across each resistor is the same, as indicated by the sound in the headphones, the reading of the meter, or the 'scope.

This condition indicates that the grid of the inverter section of the 53 tube is receiving the correct fractional part of the output of the amplifier section (equal to the reciprocal of the mu of the tube), so that no more amplification takes place, but only phase reversal; and the grids of the 45's receive exactly the same voltage, but in opposite phase. The signal used for this adjustment may come from any number of possible sources, such as a beat frequency audio oscillator, a code practice oscillator, a constant-note phonograph record, or the low voltage secondary of a transformer connected to the a.c. line; all of which should be connected in through the phonograph jack.

The loudspeaker is, without doubt, the biggest problem in an installation such as this where quality reproduction and low cost are both important factors. There is no possible substitute for a good loudspeaker; and, on the other hand, a good speaker can very rarely, if ever, be bought cheaply. Probably the best advice one can give on this point is: "Spend the most you can afford." In this case, the cost of the receiver itself is so low that you should feel justified in spending a reasonable amount on the speaker. It will be worth it in added enjoyment.

In any case, the speaker should be a 10 in. or preferably a 12 in. dynamic, and should be mounted in as large a baffle as is practical. And incidentally, this is one item which should not be subjected to skimping. A good baffle can be built for an almost nominal sum, and its boosting effect upon bass response is little short of amazing. Celotex is generally accepted as a good material for this purpose, as it is both efficient and inexpensive. Another important point to remember is that the high



L_1, L_2—Antenna and interstage coils. Meissner
L_3—85 mhy. rf. choke. Hammarlund
L_4, L_5—30 hy. filter choke. Kenyon
C_1, C_2—2-gang, 350 mmfd. variable. Reliance
C_3—.1 mfd. 200 v. paper. Aerovox
C_4—.01 mfd. 400 v. paper. Aerovox
C_5—25 mfd. 25 v. electro. Aerovox
C_6—.5 mfd. 200 v. paper. Aerovox.
C_7—100 mmfd. mica. Aerovox
C_8, C_9, C_{10}—.05 mfd. 600 v. paper. Aerovox
C_{11}, C_{12}, C_{13}—8 mfd. 450 v. electro. Aerovox
R_1—25,000 ohms pot. Centralab
R_2—400 ohms, 1 w. Centralab
R_3—50,000 ohms, 1 w. Centralab
R_4—10,000 ohms, 1 w. Centralab
R_5—50,000 ohms, 1 w. Centralab
R_6—100,000 ohms, 1 w. Centralab
R_7, R_{13}—500,000 ohms, 1 w. Centralab
R_8, R_{12}—500,000 ohms pot. Centralab
R_9—2,000 ohms, 1 w. Centralab
R_{10}, R_{11}—100,000 ohms. Centralab.
R_{14}—750 ohms, 10 w. Ohmite
T_1—Pri. 115 v. 60 cycles, Sec. 650 v. ct., 5.0 v. 2 A., 2½ v. 7 A.
T_2—Output trans. on speaker
J_1—Closed-circuit jack

frequencies are projected straight forward from the speaker cone in a narrow beam; consequently the speaker should be placed in such a position as to allow the listener to sit directly in front of it if the high frequencies are to be fully appreciated.

There are only two or three points to mention in regard to the mechanical construction of this set. Mount L1 and L2 at right angles to each other and at a reasonable distance apart to avoid regeneration in the r.f. stage, this being the cause of increased selectivity and resultant side-band cutting. For the same reason, the r.f. tube should be shielded. Mount R12 in some place where it cannot easily be tampered with; because after it has once been adjusted as described previously, it should be left strictly alone.

Aside from these details, the layout of the set is not particularly important. The illustration gives an idea of how it was done by the author, using junk-box parts almost exclusively.

During the eight months in which this receiver has been in operation in the author's home, it has given numerous demonstrations of its excellent frequency response and received the compliments of all those who have heard it. However, the most positive proof of its superior characteristics and the one which will be of the most interest to the reader is that which was shown in tests with a b.f. audio oscillator modulating an r.f. signal generator. The necessary apparatus was not on hand to take a genuine frequency response curve, but the results can easily be told verbally.

At the high end of the spectrum, frequencies up to 10 kc. came through with very little drop in volume; while the low notes kept coming through right down to the point where you could place your fingers on the speaker cone and count the cycles! An output meter indicated practically no drop in volume at 30 cps.

The effect of such an excellent response characteristic is instantly noticeable with even the poorest sort of programme. Music of any kind takes on an entirely new air of brilliance, and instruments which you never heard before come out in their full glory. Even speech sounds clearer and more natural.

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SHORT WAVES

Where? When? What?

By "Dialtwister."

Below the broadcast band as my readers know lie the short wave bands, where hours of radio enjoyment may be had, listening to the broadcasts of other lands.

The publishers have long felt the need of such a page as this in order to help and to keep readers in touch with what is doing on short wave bands.. I have been deputed to conduct this page, and I am appealing to readers to help in forwarding to me, prior to the 18th of each month, reports of what they have heard, when they heard it, and where they heard it. In doing this, readers will help me to compile a page of interesting and informative notes of the doings of the month on short waves. Reports will be published and acknowledged. The address is Box 2611 W, G.P.O., Melbourne.

Now that the summer is firmly established, reception on short wave bands is excellent in the early mornings and particularly in the evenings, when signals are strong and noise level is practically non-existant.

Probably the most interesting event of the month was the visit of the Thailand Goodwill Mission, which will, of course, bring to short wave listeners' minds the station operated by this country, HSP5, Bangkok on 25.6 metres, and can be heard between 11 p.m. and 1 a.m. any night in the week. This station was formally known as HS8PJ and operated on 37 metres.

Radio Saigon in French Indo China on 25.47 m. appears to provide some of the most reliable and enjoyable programmes, with a talented female announcer at the "mike." She has lately been relieved on occasions by a male, whose English is not "so good." English news is given at 8.45 p.m. The Americans are as usual providing plenty of entertainment and there appears to be one about somewhere at any hour of the day or night. WLWO Cincinnati on 25.27 m. has a very strong signal at night and is heard at its best about 11 p.m. KGEI, San Francisco, 31.02 m. has a good signal and "puts over" many items of Australian interest. News is given at 10.30 p.m. This station is also on 19.56 m. but the signal is not as reliable as the 31 m. band. WGEO Schenectady, 31.48m. is good in the mornings up to 8 a.m. WPIT Pittsburg, 25.26 m. good between 6 and 8 a.m. WRUL Boston, 25.45 m. is also good at this time.

In the Philippines, KZRH, Manila, 31.06 m. seems to provide the best signal being strong during the evenings. 2RO4, Rome, Italy, on 25.4 m. is a very patchy station, some nights being strong while on others very poor. PLJ Bandoeing, 20.5 m. always very strong after 9 p.m. each night, while PLP also in Bandoeing on 27.27 m. is always good in the mornings.

ZBW3 Hongkong, 31.49 m. has been reported good around about 11.45 p.m. XGOK Canton, 25.38 m. also has a strong signal. JVW Tokyo on 25.6 m. cannot be missed when tuning over the bands at night. The characteristic Japanese music makes one wonder just where all the cats came from. VUD4 Delhi 25.36 m. fairly good between 9 and 10 p.m. GSF, one of the London stations on 19.82 m. might be mistaken for a local during the evenings. DJP Berlin ("I'm doubtful if it's still there) on 25.32 m. has a steadily increasing signal.

I recommend listeners to listen to the Switzerland station, HBH Geneva, on 16.23 m. every Friday night, all announcements are made in English and French; the entertainment provided is excellent.

IMAGE FREQUENCY

By John F. Rider.

In the checking of a superheterodyne receiver, it is of the utmost importance that the local oscillator circuit be adjusted at the proper frequency. The fact that the oscillator can be tuned to a frequency which differs from that of the desired signal by the intermediate frequency **but in the wrong direction,** makes it desirable to check the alignment by being certain that the image frequency occurs at the correct point.

Let us examine the functioning of the mixer and oscillator before going into the details of the procedure.

First of all, when a signal enters a superheterodyne receiver it beats with the signal generated by the local oscillator and so a beat note is produced in the mixer tube at the intermediate frequency which has all the characteristics of the incoming signal to which the receiver is tuned. In other words, let us assume that the incoming signal has a frequency of 10,000 kc., which is picked up by the antenna and fed to the mixer input circuit. The local oscillator is tuned to a frequency of 10,450 kc., which is also fed to the mixer, where it beats with the incoming 10,000 kc. signal. The resulting signal in the output of the mixer is 450 kc.—the difference between these two signals is the frequency to which the intermediate frequency amplifier is tuned. This is the normal functioning of the superheterodyne circuit.

Now since the selectivity of the mixer input stage is seldom sufficient to eliminate undesired signals altogether, interference may be experienced due to the fact that the local oscillator in the receiver will heterodyne or beat not only with the desired signal, but also with one undesired, both being fed as a consequence to the i.f. amplifier. One type of such interference is known as image frequency response.

In the above example it was assumed that the incoming signal was 10,000 kc. and the intermediate frequency was 450 kc., being produced by the heterodyning of the 10,000 kc. signal and the 10,450 kc. frequency generated by the local oscillator. Remember that not only is the difference frequency present in the output of the mixer; there is also present the sum of the incoming signal and that locally generated: 10,000 + 10,450 or 20,450 kc. Inasmuch as the i.f. amplifier is tuned to pass signals at 450 kc., this higher frequency will not be amplified and can be considered as rejected.

However, let us make another assumption: a strong signal of 10,900 kc. is picked up by the input circuit of the receiver. This is quite possible since there is but a single tuned circuit and usually this is not sufficient to eliminate completely a strong signal which does not differ by a large percentage in frequency from that of the desired signal.

When this unwanted 10,900 kc. signal is mixed with the 10,450 kc. signal supplied by the local oscillator, it will produce a difference frequency that is equal to the i.f.: 10,900 kc.—10,450 kc.=450 kc.. Since this is the frequency to which the. i.f amplifier is tuned, the undesired signal will be amplified along with the one that is desired, i.e., the 10,000 kc. signal. This will of course create interference and the frequency at which this occurs is called the image frequency.

Now let us see what relation exists between this image frequency and the desired signal frequency. If the receiver is tuned to 10,000 kc. and the image frequency under such conditions is a 10,900 kc. the difference between 10,000 kc. and 10,900 kc., which is equal to twice the intermediate frequency of 450 kc. Suppose that the intermediate frequency were 465 kc. instead of 450 kc., then the local oscillator would be tuned to 10,465 kc. when the receiver was tuned to bring in a signal of 10,000 kc., so that the difference would be 465 kc. In this case a signal of 10,930 kc. would also produce a difference frequency of 465; that is 10,930 — 10,465 = 465 kc.; here the difference

between the desired and undesired frequencies would be 930 kc., or twice the i.f. of 465 kc. This may be stated as follows. The image frequency will always differ from that of the desired signal frequency by twice the intermediate frequency.

In the above examples, it has been shown that the image frequency is also higher in frequency than that of the incoming signal. In some receivers, particularly on short-wave bands, the oscillator functions at a frequency which is lower than that of the incoming signal. For instance, if the receiver be tuned to 10,000 kc. and the local oscillator operates at 9550 kc., an i.f. signal representing the difference between 10,000 and 9550 kc., or 450 kc., is produced.

If a 10,900 kc. signal were also present in such a mixer circuit, the beat between it and the local ascillator would result in the production of a signal frequency of 10,900—9550 or 1350 kc. Since the i.f. amplifier is tuned to 450 kc. and not 1350 kc., no interference will result. Therefore, 10,900 kc., though it differs by twice the i.f. from the desired signal frequency, will not produce interference when the oscillator frequency is **lower** than that of the signal frequency to which the receiver is tuned.

However, if a signal of 9,100 kc. instead of 10,900 kc. be present in the mixer circuit when the set is tuned to 10,000 kc. and the oscillator is functioning at 9550 kc., which is 450 kc. lower than that to which the receiver is tuned, a signal representing the difference between 9550 and 9100 kc., or 450 kc., wil be set up and therefore will pass through the i.f. amplifier, causing interference. This 9100 kc. signal, it will be noted, also differs from the desired signal frequency (10,000 kc.) by 900kc., an amount which is also equal to twice the intermediate frequency. This then is the image frequency when the oscillator is lower in frequency than that of the incoming signal.

It may therefore be seen from the foregoing examples that the image frequency always differs from the desired signal frequency by an amount which is equal to twice the intermediate frequency. Also that when the oscillator in the receiver operates at a frequency which is higher than that to which the receiver is tuned, the image frequency will always be higher by twice the amount of the intermediate frequency than the desired signal frequency. Conversely, when the set oscillator functions at a frequency that is lower than that of the desired signal frequency, the image frequency will likewise be lower in frequency than that of the desired signal.

One point should be borne in mind: image frequency has nothing to do with harmonics. While interference can also be produced due to harmonics of the oscillator beating with undesired signals, this type of interference is not due to image frequency response.

The extent to which interference is produced because of image response will depend upon the strength of the interfering signals, the intermediate frequency employed in the receiver and the percentage of difference in frequency between the image and the desired signal. Thus when the intermediate frequency is 450 kc., the image frequency differs from the desired frequency by 900 kc.; when the i.f. is 175 kc. the image frequency is only 250 kc. removed from the desired signal frequency. When the receiver is tuned to 550 kc. at the low frequency end of the broadcast band, and if the i.f. is 450 kc. the image frequency occurs at 1450 kc., which is the high-frequency end of this band. Here the percentage difference in frequency is large. On the other hand, when the receiver is tuned to 20,000 kc. under the same conditions, the image frequency at 20,900 kc. differs but little in percentage from that of the desired signal. Acordingly, interference due to this cause is much worse on short-wave bands than on the standard broadcast band.

The fact that the local oscillator on short-wave bands can often be tuned to a frequency which differs from that of the desired signal by the i.f., but in the wrong direction, makes it quite desirable to check the alignment by making certain that the image response is at the proper point.

Thus, when the receiver is to be aligned at 18 mc., the oscillator will be tuned normally to 18,450 kc. assuming the same i.f. peak of 450 kc. but if the trimmer is turned down too far, the oscillator frequency may be changed to 17,550 kc., which will

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N.S.W. Hams with Defence Forces

Hereunder we publish a list of hams serving with the Defence Forces, together with their last known rank. Further information concerning any ham on service, especially those not listed, would be appreciated by the secretary of the Division concerned.

R.A.N.

P/O Telegraphist D. Duff	2EO
P/O Telegraphist W. Watson	2YY
Lead. Teleg. W. Harris	2ALF
Lead. Teleg. R. Mitchell	2AID
Lead. Teleg. F. Tregurtha	2FT
Lead. Teleg. G. S. McLeod	2ADC
Lead. Teleg. L. Dodds	2LD
Lead. Teleg. H. Young	2AMZ
Lead. Teleg. T. Dale	2QO
Lead. Teleg. L. Bracken	2FF
Lead. Teleg. B. Chapman	2BA
Lead. Teleg. L. Meyers	2KS
Lead. Teleg. J. Williams	2ADI
Lead. Teleg. E. Clunne	2DK
Lead. Teleg. M. Sobels	2OT
Lead. Teleg. G. B. Free	2IT
Lead. Teleg. S. Clarke	

ARMY AND MILITIA (Voluntary)

Lieutenant R. Priddle	2RA
Lieutenant D. Knock	2NO
Lieutenant F. Carruthers	2PF
Lieutenant J. Fraser	2AFJ
Lieutenant A. Henry	2ZK
Corporal J. Olle	2OZ
Signaller A. Ackling	2PX
Signaller A. Pearce	2AHB
Signaller E. Simpson	2ES
Signauller E. Austwick	2NW
Sar. Major Ackerman	2ALG
Sergeant Wells	2AME
Signaller Ackland	2AJR
Sergeant Cole	2ACS
Corporal Cumptson	2AJZ
Signaller Felton	2RF
Lieutenant London	2UP
Major P. J. Manley	2UQ
Sergeant R. H. Jones	2AHF

R.A.A.F.

F/O L. Grey	2AKO
F/O A. Furze	2HF
F/Sergeant F. Hine	2QL
F/Sergeant H. Sinfield	2TZ
Corp. M. Brown	2OR
Corp. M. Meyers	2VN
F/Sergeant D. Millen	2LQ
Corporal W. M. Moore	2HZ
Corporal J. Moyle	2EZ
Corporal J. Perooz	2PE
Sergeant B. Randall	2ALN
Corporal G. Robinson	2GR
Corporal A. Wallbridge	2UI
W/O A. A. Slight	2ZA
L.A.C. C. Bischoff	2LZ
L.A.C. E. Clune	2LK
L.A.C. R. Corthon	2CC
L.A.C. G. Curle	2AJM
L.A.C. J. Evans	2CX
L.A.C. G. Fenton	2GV
L.A.C. L. Gibson	2GH
L.A.C. J. Graydon	2AIS
L.A.C. G. Hume	2AMD
L.A.C. V. Jarvis	2VJ
L.A.C. A. Llewellyn	2AH
L.A.C. McNaughton	2ZH
L.A.C. J. Parris	2DN
L.A.C. A. Reynolds	2AP
L.A.C. W. Smith	2BS
LA.C. E. White	2HA
L.A.C. J. Woodman	2ZE
A.C.1. E. Catt	2FU
A.C.1. D. Dawson	2DD
A.C.1 E. Marsella	2AEZ
A.C.1. C. Miller	2ADE
A.C.1 R. Traill	2XQ
A.C.1 J. Walters	2ALW
A.C.1 S. Weston	2AJH
A.C.1 K. J. Williams	2XD
A.C.1 L. McMahon	2ALM
A.C.1 J. M. Brennan	2ALQ
A.C.1 V. E. Tierney	2AIT
A.C.1 W. Nash	2WW
A.C.1 R. Black	2YA
A.C.1 N. McLeod	2PM
A.C.1 N. Southwell	2ZF

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Divisional Notes

IMPORTANT.

To ensure insertion all copy must be in the hands of the Editor not later than the 18th of the month preceeding publication.

N.S.W. DIVISIONAL NOTES

By VK2AJO

The lecture at the November meeting of the Division is to be delivered by Harry Stowe. Harry built his first gear in 1908, a Ford coil transmitter and crystal receiver, and commenced with the call FN, Licence No. 8, the later call signs being A-2CX and VK2CX. He is a life member of the Institute, and has chosen for his lecture the subject, "Some Recollections of the Early Days of Radio."

John Clarricoats, G6CL, states that the R.S.G.B., of which he is secretary, is growing despite the bombs, and is averaging 40 new members per month. The new edition of their "Amateur Radio Handbook," which was issued in July, is to be again reprinted owing to the demand.

We regret to note the deaths of GM8TT at Dunkirk, of G5ZQ, at sea, and G3FL in the air. On the brighter side is the award of the D.F.M. to G4HW for "shooting down five enemy aircraft and displaying a very fine offensive spirit coupled with a sense of resolute leadership."

In the U.S.A., ultra-highs appear to be holding the stage, records established during July were—112 m/c, W6BJI/6—W6KIN/6, 255 miles. 224 M/C WICOO/I—WIJK, 90 miles.

Badges and membership certificates are now available from the secretary, the badges at 2/6 per and the certificates free of charge at General Meetings. And Service Members—Don't forget to advise Wal of any change of unit, rank or address.

Lost—Con. Bischoff, 2LZ and N. MacNaughton, 2ZH.

Found—VK2AJH. Let's hear more about it, Sel!

VICTORIAN DIVISION.

To whom it may concern — and that's everyone.

Having recently accepted the post of Notes Editor to "this 'ere magazine" I'm going to appeal to you all young and old—male and female—The Magazine Committee "expects every man and woman to do his or her duty."

Just in case you don't understand what it's all about, I'll be brief—I WANT SOME NOTES FROM EVERYONE. You can help a lot if you drop a note now and again and let me know what you are doing, and if you know what anyone else is doing, so much the better. To those who are in the forces, you can help also. We want to know what you are doing (censor permitting) and how you are.

I propose to put all the VK3 notes under the one heading as the Zones are to a large extent broken up for the time being. I hope that this meets with your approval.

VK3HX, Notes Editor.

3JG—has been reported to have joined the Army Signals, is this true John?

3BG—has been posted to the R.A.A.F. station at Darwin. It's a long, long trial, Roth.

3TL—I believe is in charge of the Returned Soldiers training at Kerang.

3AH—is with the R.A.E. at Queenscliff.

3YK—Believed to have transferred from the R.A.A.F. to the Navy. Understand his rank is Sub-Lieutenant R.A.N.

3ZK—reported to have been seen flat hunting in Sydney lately. Unfortunately we can't find a query mark big enough to end this with.

3OR—recently received his commission—Pilot Officer Orr to you—to be located at the Barracks.

3KR—To be found at Century House directing signals traffic.

3RJ—after spending some time with the R.A.A.F. in Sydney is now to be found at the Barracks.

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(Continued from page 12)

likewise produce the required 450 kc. i.f. signal when an 18 mc. signal is tuned in.

To be sure that the receiver oscillator is adjusted properly, after aligning at 18 mc., adjust the test oscillator to 18,900 kc. (or whatever frequency which is twice the i.f. higher than that frequency to which the receiver is tuned) and without changing any of the adjustments, see if a signal response is obtained. If the receiver oscillator is adjusted to a frequency below that of the incoming signal, no response will result.

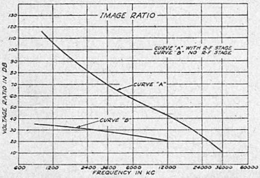
IMAGE RATIO.

When a receiver is tuned to a certain frequency, the ratio of the input signal voltage at the image frequency to that required at the frequency to which the receiver is tuned is called the image ratio.

For example, if the receiver is tuned to 1000 kc. and the i.f. is 450 kc., assuming that a 10 microvolt signal at at 1000 kc. produces a 50 milliwatt output at the receiver voice coil, then, if a 10,000 microvolt signal is required at the image frequency of 1900 kc. to produce the same output while the receiver is tuned to 1000 kc., the image ratio is 10,000/10 or 1000.

Curves showing how the image ratio becomes lower as the frequency to which the set is tuned is increased are shown in the accompanying chart. In this graph Curve A is representative of the image ratios secured when an r.f. stage is used ahead of the mixer in a high-grade receiver, while Curve B shows the lower image ratios which result when no r.f. stage is employed.

In the first mentioned curve, the image ratio resulting when the set is tuned to 1200 kc. is 106 db, corresponding to a voltage ratio of



200,000 to 1. That is the signal input at the image frequency must be 200,000 times that required at the frequency to which the receiver is tuned, to produce the same output. This ratio decreases on the higher frequency bands because of the relatively small percentage difference in frequency between the image frequency and the desired frequency on such bands. At 12 mc., the image ratio is 43 db or 140 to 1, while at 36 mc. it is only 11 db or 3.5 to 1.

The improvement resulting from the use of an r.f. stage is much more evident at frequencies in the broadcast band than at higher frequencies. As shown in Curve B, the ratio secured with a representative receiver employing no r.f. stage is 34 db or 3500 to 1, at 1200 kc. compared with 200,000 to 1, which is obtained with a set employing an r.f. stage, over 50 times as great. Yet at 12 mc., where the image ratio on Curve B is 20 db, or 10 to 1, that obtained with the set using the r.f. stage is 140 to 1 at this frequency—only 14 times better. It is thus evident that the improvement decreases more rapidly at still higher frequencies.

(Continued from page 15).

3SQ—spending most of his time at the Marconi school.

3FR—although selling all the best in radio (so he tells us) has built himself a receiver from his junk box, a T.R.F., too.

3YI—does a little listening on the short waves.

3WY—tells us that he is going grey. We are wondering why.

3QS—works while we sleep. and sleeps while we work.

3PR—let's hear from you, Ron.

3CE—same goes for you, Roy.

3II—one of our vice-presidents. What about a note from you, Lee?

(Continued from page 13).

A.C.1 J. Edwards	2AKE
A.C.1 G. Thornton	2IP
A.C.1 K. Sherlock	2TQ
A.C.1 E. L. Aked	2AEU
A.C.1 R. Stacey	2HY
A.C.1 L. D. Cuffe	2AMA
A.C.1 R. W. Eagling	2AEY
A.C.1 A. Manwaring	2AJK
A.C.1 A. Potts	
Radio Instructor N. G. Beard	2ALJ
A.C.1 B. Dale	2XX/9XX

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